



News and Views

The effect of enhanced working memory on language

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Although we are in almost complete agreement with Martín-Loeches (2006), his critique of our argument presents us with an opportunity for clarification. We commend his description of the possible neural basis for enhanced working memory (EWM), especially the possible role of parallel activation. As he makes clear (clearer than we did), EWM need not have been based in a massive increase in the number of neurons.

We differ from Martín-Loeches primarily in our treatment of language. One of our motivations for advancing the EWM hypothesis was a desire to challenge the heavy (and often uncritical) reliance that many anthropologists place on language as the key to cognitive modernity. Language is such a powerful ability, and our understanding of it is so much more comprehensive than that of many other cognitive abilities, that it tends to eclipse our understanding of all other developments. Martín-Loeches' reworking of our argument for the phonological loop reflects, we believe, this "bullying" effect of language, and syntax in particular. We suggest that much of what Martín-Loeches attributes to a language processor might be more parsimoniously explained by elements of Baddeley's original model of working memory. One component of WM mentioned, but not emphasized, by Martín-Loeches is its access to long term memory (LTM). Ericsson (Ericsson and Delaney, 1999), for example, has built a powerful explanation of expert performance based on facilitated access to LTM via WM. In essence, cues held in and manipulated by WM provide quick access to much longer and more complex encodings held in LTM. This strikes us as being precisely what happens in Waters and Caplan's (1996) "psycholinguistic resource pool," when the "more automatic" access to complex syntax occurs. In other words, this cognitive ability may be a general feature of WM tapping into a long term store of syntactical models, rather than anything specific to language. And the "post-interpretive processing" used in verbal

reasoning strikes us as a function of the episodic buffer of the central executive, rather than a separate module.

It is interesting that our differing accounts of the relationship between language and WM ultimately take us to the same place, for we too would argue for Martín-Loeches' second evolutionary scenario – that the developments in WM that produced the modern mind enhanced the capabilities of an already-existing language (syntactical) processor. Recursion provides a telling example of how this would have worked (and especially pertinent as some linguists now maintain that recursion is the crucial piece to syntax [Hauser et al., 2002]). Recursion is the mechanism in grammar that enables a speaker to use an entire phrase as an object of a higher level phrase (e.g., "He said that she said."). It is this feature that supplies native speakers of a language with the ability to produce, in principle, an infinite number of meaningful sentences. In practice, the size of this "infinity" is constrained by several practical limitations, one of which is WM. The number of recursions must be held and processed in attention if they are to be understood. "He said that she said that they said that we said that I said that George W. Bush is a true Texan," is a grammatically correct sentence, but one that just about exhausts the capacity of WM to analyze. Add two more levels of recursion and few native speakers could keep track. The recursive rule, held presumably in a syntactical processor, has not changed, but the sheer size of the task has. Perhaps the simplest interpretation of the effect EWM had on linguistic communication is to conclude that it enlarged the recursive capacity of language. An enhancement of WM would yield immediate results in the length and complexity of sentences. Martín-Loeches may well be correct in arguing that the phonological loop, *sensu strictu*, is too specialized (or too encapsulated) to adequately encompass this increased capacity (TW and FC themselves disagree amicably on this point). However, we are also reluctant to subdivide WM into smaller and smaller subsystems if features of the general model can account for the experimental results.

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Resolving this difference in interpretation is of course not a minor point, as it bears on the whole nature of the interrelationship between language and WM. However, the current understanding of WM is still far from complete, and we can only hope that further research will clarify the relationship.

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